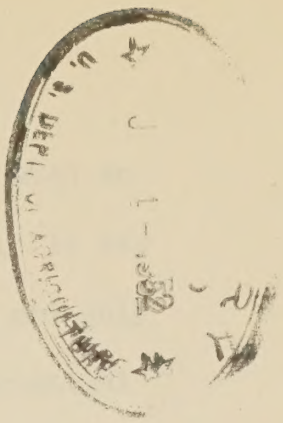
IMPROVEMENT IN THE PREPARATION OF DEHYDRATED EGGS FOR INCREASED STORAGE LIFE

By

G. E. Hilbert, Chief
Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
United States Department of Agriculture



Status of the problem:

The transformation of eggs into a more stable form is of obvious importance in answering both peace- and war-time needs. Seasonal fluctuations in egg production can be leveled by storage of the product in a stable form whereas in cases of emergency, when shipping space and refrigeration facilities are scarce, a concentrated as well as more stable form of egg is of primary importance.

During the last war a great deal of research was done in British, Canadian and United States laboratories in improving dried whole egg stability, especially its stability at temperatures ranging up to 100 degrees F. The greatly increased production of dried whole egg powder in the United States from only 184,000 pounds in 1939 to nearly 320 million pounds in 1944 created many problems requiring study, the most important of which concerned improvement in quality and storage life. The United States peak production of 1944 represented the equivalent of 10.6 billion eggs or 18% of farm egg production. Modifications in processing and packaging methods led to the production of whole egg powder of stability definitely improved over that available at the start of the war.

Nevertheless, the best product procurable immediately after the war, when subjected to moderate or elevated temperatures, still failed to exhibit satisfactory stability. Thus a gas-packed, 2% moisture powder held at a

temperature of 100 degrees F., deteriorates in about one month to such an extent that it is considered unsuitable for use in scrambled eggs. It was recognized, therefore, that still further improvement was needed, not only for the obvious application in military usage, but also for the potential utilization of dried whole egg as a stable peace-time commodity, and for the preparation of egg powder as a truly stable form for stock-piling purposes.

Acidified whole egg powder:

With the foregoing wide objectives in mind, the Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, undertook anew research to improve whole dried eggs. Two processes have resulted from these researches. The first, developed toward the end of World War II, involves the acidification of the egg magma prior to dehydration. The acidification step is accomplished by addition of sufficient chemically pure hydrochloric acid to liquid egg under agitation to reduce the pH to 5.5. The acidified liquid egg is then dehydrated in the normal way. To the resultant powder is incorporated an amount of bicarbonate of soda equivalent to the acid originally added. This product has a shelf-life vastly improved as compared with egg dehydrated in the usual manner and when reconstituted differs in no way from its initial condition except that it contains a little salt. Acidification of the egg appears to retard certain chemical reactions between sugar and protein which make dried egg powder less stable. Following tests that lasted several years, the U. S. Army Quartermaster Corps in September, 1949 (MIL-E-10006(QMC-with amendment I; Egg, stabilized, dehydrated) issued specifications for acidified dried egg and bids were requested in the latter part of 1950.

Glucose-free whole egg powder:

The second process employs fermentation to remove the small amount of sugar normally present in egg magma. During the last several years, extension of the various wartime research results led to the discovery that one of the most important chemical reactions leading to flavor deterioration of dried whole egg is that between the sugar, glucose, and the yolk fat constituent, cephalin. It has now been conclusively demonstrated that glucose, the known aldehydic substance of egg, is the reactive aldehyde involved in the reaction with cephalin during storage and that this "browning" reaction is probably the major cause of off-flavor development. The small amount of glucose normally present in egg powder (1.2% of dry weight) had been previously shown by British investigators to be implicated in protein alteration during storage, i. e., removal of glucose before drying was shown to essentially prevent losses in protein solubility during storage. Unfortunately, the yeast process used by these workers to remove glucose introduced sufficient foreign flavors in scrambled eggs (prepared after reconstitution) to preclude evaluation of possible beneficial effects of glucose removal on flavor retention.

A yeast fermentation process has now been developed by the Bureau of Agricultural and Industrial Chemistry based upon optimum conditions with regard to amount and type of yeast, pH, temperature, time, etc., whereby spray-dried glucose-free egg powder can be prepared commercially in which foreign flavors are not detectable by a trained taste panel. Since the products of the fermentation, carbon dioxide and alcohol, are volatilized during the drying process, the term "fermented egg powder" sometimes used is misleading and the term "glucose-free whole egg powder" is preferred.

A commercial scale run (1200 pounds of liquid whole egg) has shown that the procedure is practical. The improved (glucose-free) dried egg is about six times as stable under adverse storage conditions as ordinary dried egg. More specifically, the flavor of a glucose-free powder containing 2% moisture and packed in a nitrogen atmosphere, could not be consistently distinguished from that of a control sample even after two months storage at 100 degrees F., while the normal egg powder under similar conditions was considered unfit for table use after one month's storage. Differences in the baking quality, as measured by sponge cake volume are equally striking. A glucose-free egg powder containing 5% moisture and stored six months at 100 degrees F. made an acceptable cake while the normal egg powder after storage under identical conditions failed to make a cake, in fact, the batter failed to rise.

The Quartermaster Corps is very much interested in dehydrated egg of enhanced storage stability and is conducting tests now in cooperation with the Bureau of Agricultural and Industrial Chemistry designed to compare relative merits of the two foregoing processes. In spite of the vast improvement in stability that can be accomplished by acidification or glucose removal prior to dehydration, the dried product still deteriorates from other causes. Because egg powder is more stable when it is packed in the absence of air, it is known that some of the remaining deteriorative reactions are induced by oxygen. Other reactions involve neither oxygen nor glucose, but are concerned with chemical changes that occur during processing and during storage of glucose-free dried eggs. Solution of these chemical problems together with solution of the Salmonella problem would make it possible to take full advantage of the space and weight saving and convenience factors possessed by dried eggs. This is the ultimate objective of further research.

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